Section 3
Getting Ready

GETTING READY

3.1 GROWING NATIVE PLANTS IN THE NURSERY: AN OVERVIEW

This section provides an overview of the main steps involved in growing native plants at Oceana Native Plant Nursery. In the sections that follow, instructions will be given to help you accomplish each step with ease and confidence.

- Start with (and maintain) a clean nursery.
- Collect seed or take cuttings at Milagra Ridge.
- Prepare potting mix and pots and/or flats.
- Process seed or cuttings:
  - Seed is usually dried, stored, accessioned (notes recorded on all seed gathered, entered in the data base), and sometimes treated in a variety of special ways so it will be ready for germination when it is sown.
  - Cuttings must be kept moist, trimmed, and cleaned, and then put into flats.
- Sow the seed (usually in pots) or place cuttings in flats with proper mix.
- Label racks/flats, water plants, place in greenhouse, record data in Propagation and Transplant Records.
- Keep the plants healthy with frequent misting and daily nursery checks for pests, disease, or watering problems.
- Thin out plants to one per pot where necessary.
- Transplant where necessary.
- Consolidate and re-sow empty pots or pots without live plants.
- When they no longer need frequent misting, transfer plants into shade house.
- Continue to check and water plants daily, usually in the morning.
- Prune plants as needed.
- Fertilize plants as needed (three months after initial sowing).
- Continue daily checks to spot and treat any pest, disease, nutrition, or watering problems.
- Consolidate when plants die.
- Outplant beginning in December!

3.2 NURSERY HYGIENE: TEN TIPS TO REMEMBER

Cleaning up: You just can't get away from it. At the nursery, as at home, we have to clean up after ourselves. We try to keep the seed and potting areas as clean as our home kitchens for the same reason: to prevent infection. Here, we are keeping our plants healthy rather than our families. Fungal spores, bacteria, or insect eggs can be hiding in the soil on the ground, on the bench, or in that used pot. We reuse our pots planting after planting, but in between, we wash and sterilize pots and flats. This is an important secret to success in growing California natives. They are very susceptible to fungal diseases carried in warm moist soils because they have evolved here in California, where soil is moist in the cold months of the year and dry during the warm months. We have to water the pots in the summer, and we reduce chance of infection by keeping the pots and working areas clean. It's not just aesthetics when we ask you to sweep up or wash pots. It's an essential step in raising healthy plants for your park.

Many problems can be prevented with good **sanitation** practices. It's much more efficient and safe to prevent problems with your plants than to use chemicals trying to save plants once they've become diseased or damaged by fungus or other pests.

Here are ten tips for plant protection through good hygiene.

1 When you walk on the ground, you pick up fungal spores and bacteria on your shoes. Do not put your feet in the potting mix or piles of amendments, sand, redwood compost, etc., or you will transfer these "germs" into the potting mix.

2 Never let the hose nozzle touch the ground. Always hang it over the hose bib when finished watering. The nozzle can pick up spores from the ground and then you'll water them in to the plants.

3 Keep racks of plants, particularly seed and cutting flats, off the ground and off unsterilized tables and benches.

4 If a shovel or other tool has been used in field soil, sterilize before using in the potting mix pile.

5 Rinse empty benches with a high-pressure hose and a bleach solution to clean off spores, insect eggs, snails, and soil.

6 Once a year, after planting season when the nursery is basically empty, high-pressure spray the tops and undersides of the benches. Bugs and snails hide there, just waiting until you leave to party. Pick up all pallets and hose soil off. High-pressure hose the pallets.

7 Keep greenhouses and underside of benches free of weeds. Bugs and diseases hide in them, and weed seeds spread.

8 Put snail barrier pans or copper strips on benches to deter slugs and snails. They love those baby plants—lupines are snail ice cream.

9 If using a wheelbarrow, 5-gallon bucket, or soil pan for wetting soil mix or mixing cutting media, wash container and mixing tool in bleach solution first (use about 1 teaspoon of bleach per 1 gallon of water).

10 Handle the plants as you would handle food for your family, including **no smoking**.

3.3 SEED COLLECTION GUIDELINES

As a general rule, we collect seed from the watershed in which the new plants will be placed. Seed from plants adapted to a particular site is more likely to produce new plants that will also be successful in that site. Also, we don't want to pollute the population with outside genes that may have an adverse effect on the habitat. Just as exotic plants can be detrimental to a habitat, non-local indigenous plant genes could also cause problems.

In revegetation, we seek to create a self-sustaining habitat. In order for plants to successfully reproduce and continue to evolve as site conditions change, there must be sufficient genetic diversity within each species in the plant population at the site. Therefore, we strive for a balance of locally adapted plants, with as much genetic diversity as possible within those plants.

The rules that follow are designed to help us achieve these goals.

■ Seed may be collected only for an approved project. Please verify with the project manager that the project review or restoration action plan has been approved.

■ Each project manager or nursery manager must keep records of where seed has been collected, so that too much seed is not taken from an individual area.

■ Over the course of the collecting season, take no more than 5 percent of available seed from any species within an area (unless this is a site that will be completely destroyed due to development). This leaves sufficient seed for natural regeneration in the collection area and avoids reduction in the gene pool.

■ Seed should be collected from the watershed or site in which the project will be planted. If there is insufficient seed source in that watershed, permission must be obtained from the park's plant ecologist to collect from another area.

■ If a plant is to be reintroduced to an area in which it no longer exists, a reintroduction plan must be completed and approved before planting.

■ When possible, look at the soil at the site where planting will be done and keep it in mind when collecting. Try to collect from a similar soil type.

■ Collect throughout the geographic range of the plant within the collection area. Don't select only plants that are growing on flat ground when the project will be planted on a slope, for example.

■ Collect each species needed for the project several times throughout the seed ripening period to get early, mid-season, and late-ripening seed. We don't want all late-ripening seed. The late-ripening seed should be combined with the early- and mid-season seed so that when all are sown, they replicate natural ripening variation. This will maintain a variety of plants and seed for our site in the future.

■ Collect from as many plants of a single species as possible throughout the collection area, but never less than ten plants. Do not bother to collect from only one plant. If there are fewer than ten plants, check with the plant ecologist to decide whether to use the available plants or to go outside the watershed.

■ Complete required paperwork and return it to your mentor or the seed collector for the project:

- Seed collection record for each species collected within a collection

area (you may have multiple dates of collection on a record).

- Work record, with time spent collecting the seeds.

3.4 SEED FORMATION AND MATURATION

Pollination and Fertilization

Did you know that seeds develop where the flowers were? Of course you did. But you'd be amazed at how many people don't know that. Flower petals are there to attract **pollinators** such as bees, butterflies, birds, bats, and other insects. Flowers that are **wind pollinated** (grasses, coyote bush and oaks) usually have inconspicuous petals since they do not need to attract pollinators. A flower may be **self-pollinated** when the pollen from the **anther** of a flower brushes the **stigma** of the same flower. A flower may be **cross-pollinated** by a plant in the same genus, species or variety, if there is at least some variation in one or more genes.

Pollen floats or is carried from the **stamen** (the male part) of one flower to the **pistil** (the female part) of another (or sometimes the same) flower. The pollen grain contains a set of genes from the male parent plant. The top of the pistil (the stigma) is sticky to hold the pollen. The pollen germinates and grows a tube down through the **style** to the **ovary**, at the bottom of the flower. The **pollen tube** may be only 1/4-inch long, or it may be 12 to 15 inches long, as they are in an ear of corn (corn silks are styles). The pollen tube grows through the ovary towards one of the **ovules**.

There are two **sperm cells** in the apex of the pollen tube. Each contains an identical set of genes. One sperm cell combines with the egg cell in the ovule (which also contains a set of genes from the mother plant). This begins the **zygote** that will become the embryo of the new plant. The other pollen sperm cell combines with the female **endosperm** cell (which will soon feed the developing seed). This is "**double fertilization**." A different pollen grain must reach and fertilize each ovule. If it's not fertilized by a pollen grain, the ovule usually won't develop. That explains those little, skinny, white ovules in your water-

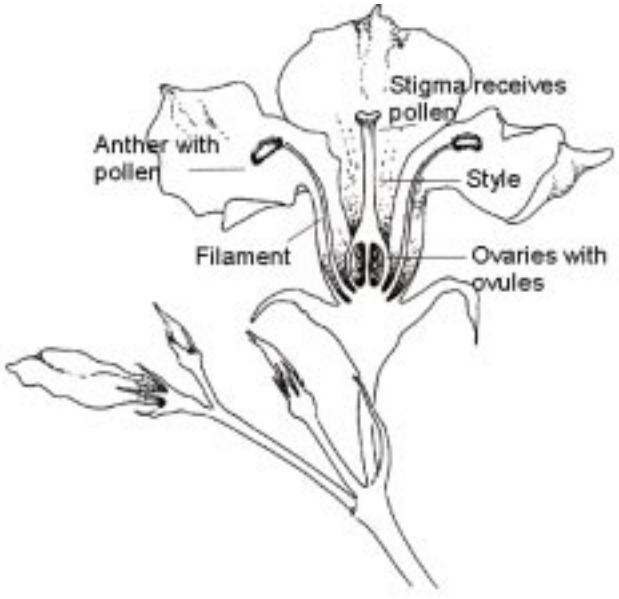

Figure 3.1. Reproductive parts of the flower

melon; they were never fertilized and are not viable seeds.

Maturation

After fertilization, the endosperm develops before the zygote and feeds the developing seed. The endosperm is the milk or dough squeezed from an immature seed. The zygote begins developing into the **radicle** (which will become the roots), the **plumule** (which will become the leaves and stem), and the **cotyledons** (seed leaves). Finally, the **integuments** of the ovule turn into hard seed coats in a mature seed. When the seed is mature it gains no further dry weight and the endosperm is depleted. When the mature seed germinates, the first true leaves will begin manufacturing food to feed the new plant.

Fruit Development

The ovules grow into seeds and the ovary grows into the fruit. When you sink your teeth into a juicy peach, you are eating the mature ovary. This ovary or fruit is part of the mother plant, with the same genetic makeup as the mother plant. But the seed inside the ovary is a combination of genes from the father plant and the mother plant. That's why we like to use seeds to grow plants for our projects-because each one is genetically unique, and will maintain the natural diversity of the species.

Seed Types

Many types of fruits have evolved over time. Here are the scientific terms for a few you may be familiar with or find:

- **Legume** or pod. Formed from a single carpel, **dehisces** (splits open) along both sides; examples include lupines and other plants in the Pea Family.
- **Follicle**. Formed from one carpel, but opens on only one side; magnolia has this type of fruit.
- **Capsule**. From a compound ovary, having more than one carpel; iris, poppy, and plantain form capsules.
- **Silique**. Like a pod or legume but with two carpels, dehisces into three portions; wallflower and many plants in the Mustard Family form siliques.
- **Achene**. These do not dehisce, usually have multiple dry fruits on a head;

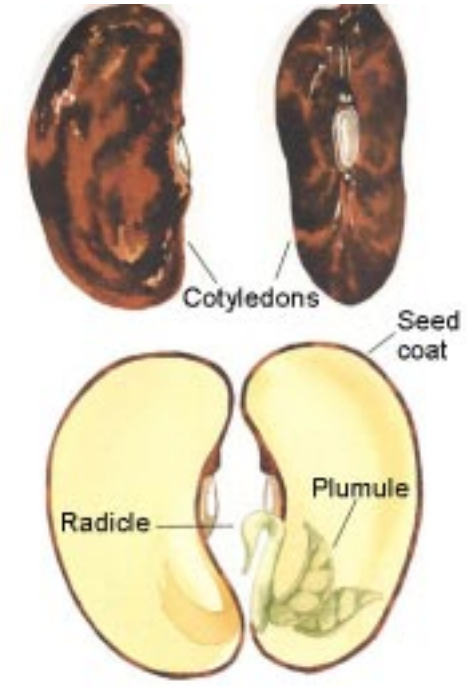

Figure 3.2. Mature Seed Structure

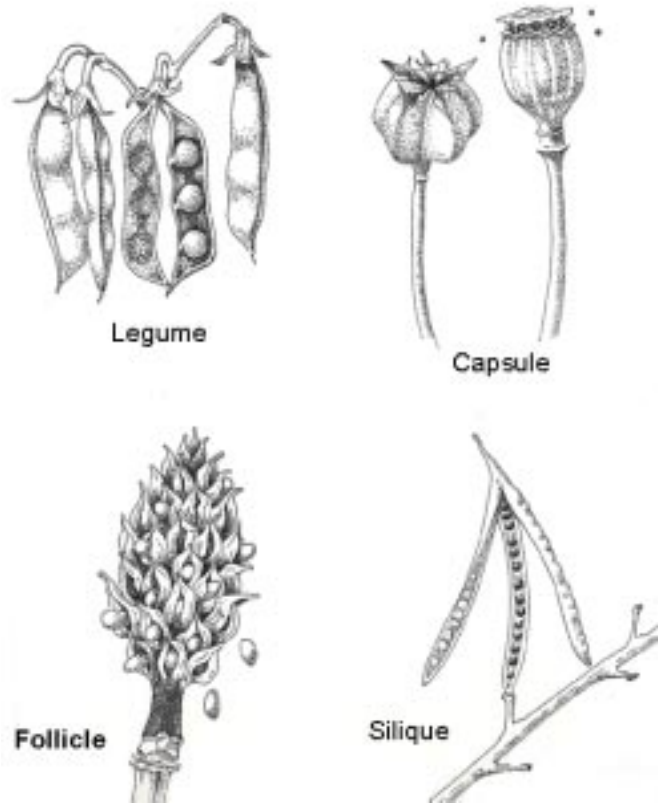

Figure 3.3. Different fruit types

strawberry, buckwheat, and sunflowers form achenes.

- **Grain**. Dry fruits of the grass family; one-seeded and indehiscent.
- **Samara**. Winged, dry, indehiscent; big leaf maple forms samaras.
- **Schizocarp**. Dry fruit of two carpels that split in the middle to two one-seeded indehiscent halves; poison hemlock is one example of many in the Carrot Family.
- **Nut**. One-seeded, indehiscent dry fruit with a hard or stony shell; hazelnuts and acorns are local native examples.
- **Drupes, berries, pomes, pepos and aggregates** make up the fleshy fruits.

3.5 SEED COLLECTION TIMING

There is no one magic answer to the question, “How do I tell when it’s ripe?”. Each species varies. See the Seed Collection Calendar (page 31) for general guidelines.

Confidence comes with experience. Usually, a seed is mature if it can be removed from the plant easily. If you have to tear it off, it’s usually not ripe. If you squeeze the seed and a milky or doughy substance oozes out, this is endosperm and means the embryo is not fully developed and will not germinate. If the seed is particularly tiny, light-colored, or thin, it’s not ready to be harvested.

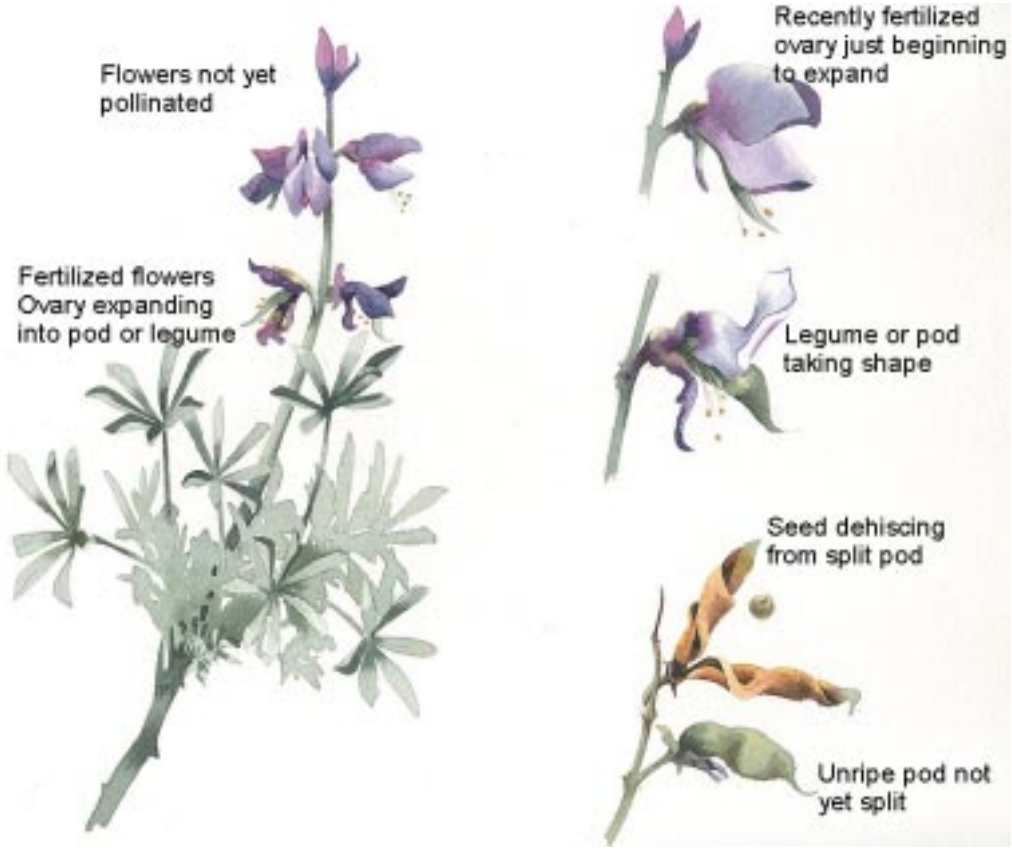

Figure 3.4. From fertilization to seed

In grasses and some dicots, seed goes through three stages:

- **Soft doughy stage**, indicated by the milk or dough that can be squeezed out. Seed gathered at this stage is immature and will not germinate.
- **Hard doughy stage**, which can be judged by biting the seed. If the seed does not extrude milk or dough, it is near maturity. Hardening of the seed coat is the last step in maturation of the seed.
- **Maturity**, indicated by a very hard seed coat and usually dark color or at least no green in the color of the seed.

For grasses, seed should be collected during the hard doughy stage. For annuals and herbaceous plants, seed is generally ripe about one month after flowering. In woody plants, seed maturation can take several months to many years. For example, black oaks take two years and orchids take seven years.

Germination rates are much higher if the seed is fully mature. In plants with dehiscent seeds (California poppy and lupines, for example), collection must be done a little early before the seeds pop open, blow away, or the critters beat you to them. When ripe, the pods should still be dry and stiff. If you are not sure if the seed is fully ripe, collect several inches of stem with the inflorescence. The stored food in the stem will promote a further maturation.

It is best to collect early- and late-maturing seed within the collection area. This assures the broadest genetic mix in the

plants to be outplanted. Seeds on a single plant can mature at different rates. Collect only the seeds that are ready; come back for the late-ripening seed.

How well the seed germinates and grows depends not only on its maturity at time of collection but on other factors, including genetics, handling during collection, cleaning and storage, insect damage and disease. Any of these factors can decrease the number of healthy plants obtained from the seed collected. See the next section, "Seed Collection Hints," for more details on handling seed.

3.6 SEED COLLECTION HINTS

When collecting, avoid infected plants or those under attack by insects. Keep seeds out of the sun and in a cool, shady place both during and after collection. For dry seed such as grasses, collect in the afternoon when the plants are the driest.

Grasses and dry, papery seed

- As a general rule, dry, papery, or hard shell seed should be collected in a paper bag.
- Grasses (*Nasella pulchra*, *Bromus carinatus*, *Elymus multisetus*) can be collected by *gently* pulling the spike between thumb and forefinger; position the palm of your hand below to catch falling seed. Ripe seeds separate easily, unripe seed does not.
- Seeds of other grasses (*Koelaria macrantha*, *Elymus glaucus*, *Hordeum brachyantherum*, *Danthonia californica*) are firmly attached to the stem and are best collected by taking off the entire spike.

Composites-daisylike plants

- Some, like coyote bush, are easiest to collect by gently taking a handful of seed and placing it in a paper bag, or by putting a paper bag over the branch and shaking.
- The ripe seed will fall into the bag or float away. Look closely at the fuzz - the seed is the tiny dark brown dot at the base of the fuzz, and it should be brown, not tan.
- For other composites, cut off the whole flower head when seeds do not shake free readily and put flower heads in a paper bag.

Shrubs and Trees

- If the plant has berries, pull them off and place in a plastic bag.
- Acorns should be picked from the tree; they are ripe when the acorn twists from the shell without tearing. Acorns and buckeyes are put in open plastic bags.
- A grocery bag with handles works well to carry moist seed. If you are collecting several species at once, you can carry smaller bags of seed in the grocery bag; hanging the bag over your arm leaves you with both hands free to collect more seed.
- Keep the collection bag out of the direct sun at all times.

Record Keeping

Label each bag with:

- Watershed and sub-watershed names (check map)
- Project name
- Common name, botanical name, or four-letter code
- Date collected
- Collector's name
- Description of area
- Time spent collecting
- Percent of seed collected from the area
- Comments

Aftercare

Each step in the seed-collecting process is vital. Hours of careful collection are wasted if seeds are improperly handled after collection.

- If you have any moisture at all in the seed, or if the volume is more than a handful, spread seed out to continue drying. Seed moisture content needs to be reduced to 5 to 10 percent for successful storage and to avoid fungal problems. Typically, seed contains 16 to 20 percent moisture when harvested.

- Seed should be stored in a cool shady place until it is given to nursery for cleaning and storage. The sun can literally cook the seeds.

- Berries or acorns must be cleaned within one to two days or they will mold. Store no more than one-half of a grocery sack full of acorns, otherwise they will start composting.

Cleaning and Storage

We do not clean and store seed at Oceana, but other nurseries in the park do. In general, seed is cleaned to remove berry skins, pulp, or dried flower parts. Seed is thoroughly dried and stored in airtight containers (jars, ziplock bags, or plastic boxes). It is refrigerated if the nursery has the equipment. This is done for the same reason you put perishables in the refrigerator at home: they last longer.

3.7 SEED TREATMENTS

Some seed can be sown fresh (without any special treatment), like many of our coastal **herbaceous** plants (yarrow, brome grass, Phacelia, and others we grow at Oceana) and woody plants (buckeyes). However, most seed will not grow if it is just stuck in a container with soil and watered. Many species require **stratification**, or cold treatment, prior to germination. Each species has its individual germination requirements, which may include fire, cold, consumption by a bird, etc.

We try to fulfill those germination requirements by doing something to the seed to imitate what usually happens in nature. Treatment time is determined by counting back from the date they should be sown. Depending on the species, seed is usually treated in fall or winter. If seed treatments are not happening at Oceana and you would like to participate in this activity, speak to your mentor about going to one of the other park nurseries to help with the process there.

For seed that would in nature be eaten by a bird, we put the seed in a rock tumbler with sandpaper or acid (strong coffee). For seed that requires fire for germination, we use either acid or hot or boiling water (**scarification**). For seed that would normally germinate in winter (but that we want to germinate earlier, in spring/summer/fall, so roots are already well established by winter), we put the seeds in moist media and into the refrigerator (stratification).

Seeds must be moist so they can **imbibe** water and the compounds inhibiting germination can be broken down into enzymes that induce germination. Many seeds require scarification and stratification. Ceanothus, for example, is put in boiling water for twenty seconds, allowed to soak overnight, and then stratified for sixty to ninety days. Bay and walnuts may need four to six months of stratification.

3.8 SEED COLLECTION CALENDAR

Start Date	End Date	Scientific Name & Common Name
April 1	June 30	*Lupinus chammissonis*/ lupine
April 1	July 15	*Festuca rubr*a /red fescue (grass)
April 15	June 15	*Elymus glaucus* ssp. *glaucus* (grass)
May 1	July 30	*Erysimum franciscanum*/wallflower
May 1	August 30	*Eschscholzia californica*
June 1	October 31	*Phacelia californica*
June 1	June 30	*Armeria maritima* ssp. *californica*
June 1	August 30	*Castilleja* sp./Indian paintbrush
June 1	July 30	*Caenothus thyrsiflorus*/blue bush
June 1	August 30	*Erigeron glaucus*/seaside daisy
June 1	September 30	*Mimulus aurantiacus*/monkey flower
July 1	October 31	*Achillea millefolium* /yarrow
July 1	August 30	*Eriogonum latifolium*/buckwheat
July 1	September 15	*Anaphalis margaritacea*/cudweed
July 1	August 30	*Dudleya farinosa*
July 1	August 30	*Lathyrus littoralis*/pea
July 1	September 30	*Scrophularia californi*a/bee plant
August 1	October 15	*Abronia latifolia*
August 1	October 30	*Artemisia pycnocephala*/sage
August 1	October 30	*Eriophyllum staechadifolium*/lizardtail
September 1	November 30	*Baccharis pilularis*/coyote bush
September 1	September 30	*Rhamnus californic*a /coffee berry
November 1	December 31	*Heteromeles arbutifolia*/toyon